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Curriculum Redesign: The Use of Learning Design Principles

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CURRICULUM REDESIGN: THE USE OF LEARNING DESIGN PRINCIPLES

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A Project Proposal

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SECTION I. BACKGROUND AND GOALS

Project Summary

The Ohio Attorney General's Center for the Future of Forensic Science at Bowling Green State University sought an opportunity to redesign the training curriculum for their researchers and scientists. The original curriculum was presented to employees in a classroom setting with the use of a PowerPoint file.

Jon E. Sprague, Director, and Jeffrey J. Lynn, Chief of Forensic Standards and Training, led this initiative to update the original training materials. The first training program to be developed was intended to be a 20-minute, individual e-learning experience, designed to be completed through a web browser. The overall goal of this project was to implement key learning design and user experience design principles to create a more engaging, motivating, and interactive form of training.

Proposed Objectives

The objectives of this project were to:

(1) Evaluate the current condition of the training materials;

(2) Create a self-paced, 20-minute, online learning experience;

(3) Increase learner motivation through the use of learning design and user experience design principles.

Description of Resources

To successfully complete this project, a number of resources were needed throughout the project process. There were three main parties involved: the subject matter experts, the learning designer, and the developer.

In addition to leading this important training initiative, Jon E. Sprague and Jeffrey J. Lynn also served as the subject matter experts for this project. The role of a subject matter expert is to support the course development goals, share context of the learning need, and provide insight on the skills needed for learners to improve their performance at work (Davis, 2014). Jon has a background in pharmacology and toxicology and provided his expertise on the content related to chemistry. Jeffrey has a background in forensic science and management and provided his expertise on training and employee skill certification.

Jaclyn Kinsey was the learning designer for this project. The learning designer implements many user experience design principles and concepts and focuses on improving learning outcomes and the quality of the learning experience (Peters, 2012). The learning designer for this project also managed the project process. For this project, the learning designer also created the graphics and edited the photos that were used in the e-learning course.

The third resource that was needed for this project was the development team. Dr. Joseph Chao, Associate Professor at Bowling Green State University, led the development team. Dr. Chao manages his own programming and development company, Agile Oasis, which specializes in creating custom software solutions.

Literature Review

This literature review is focused on learning design in corporate training curricula. The primary areas of focus include context, defining learning design, and how learning design can be used to increase learner motivation in e-learning environments.

Context

Effective instructional design is a crucial success factor of e-learning quality and helps learners achieve learning objectives and gain knowledge efficiently (Massy, 2002). Besides the importance of e-learning usability, it is imperative to strive for a more holistic view when

designing modern e-learning applications. This holistic view not only includes aspects of instructional design, but also user experience design. The term *user experience* emphasizes that when we make product design decisions, we are having an impact on real people (Zaharias, 2013). We are not just designing a product; we are designing an experience. Delivering a superior online learning experience requires a careful blending of concepts and methods from the domains of both instructional design and user experience design. The concept of blending concepts from domains is called *learning design*.

Many organizations have implemented e-learning initiatives to replace their traditional instructor-led training. This initiative allows organizations to save money while offering employees more flexibility and convenience (Jones, 2013). Unlike instructor-led training, which requires employees to schedule a specific day and time to sit in a room with other employees and the trainer, e-learning requires employees to use self-discipline in order to complete the training. Through the use of web-based e-learning, employees are expected to complete the training at their convenience among other demands that their job requires of them (Jones, 2013).

There are motivational problems that arise with this type of training, such as high drop-out rates, users feeling isolated, and the level of interaction not matching that of a face-to-face training session (Keller & Suzuki, 2004). Instructors and designers do not always take into consideration all of the crucial elements of teaching, including the motivation of their learners. A common misconception of e-learning students is that they are active learners and are seen as being independent, self-motivated, and having a positive attitude towards learning (Nehme, 2010). Nehme (2010) states, “the implementation of techniques that encourage motivation will ultimately affect students’ level of engagement and their willingness to persist at a task” (p. 233).

Overcoming motivational challenges in e-learning can be difficult because of the complexity of human motivation (Keller & Suzuki, 2004). So how do we overcome these challenges? Zaharias (2005) explains that a more learner-centered approach that uses cognitive research, instructional design principles, and user experience design can be used to address this emerging issue in e-learning. Learning design is an effective solution because it puts learners and their characteristics as the main focal point in e-learning design and emphasizes effective learning factors, especially motivation to learn (Zaharias, 2005). The solution to increasing student motivation is a better design for learning.

With the rise of online educational applications, corporate e-learning, and online degrees, a new form of user experience design emerged. User experience designers are experts on how people use technology, not on how people learn (Peters, 2012). For e-learning to deliver high-quality, interactive, and engaging learning experiences, designers must incorporate user experience design principles as well as educational theories and psychology into the development of any e-learning module.

Defining Learning Design

Soloway, Guzdial, and Hay (1994) were among the first to identify a need for designing learner-centered environments and technologies that address the users as learners. They pointed out the need for a learner-centered design paradigm as the equivalent approach of user-centered design. The practice of learning design implements many of the same user experience design principles and concepts, except the main focus is improving learning outcomes and the quality of the learning experience (Peters, 2012).

Learning design is made up of two domains: instructional design and user experience design. There are common misconceptions in each field, so it is important to clearly define their role and contribution in learning design.

As stated previously, learning design and user experience design are closely related. Two approaches that highlight this thinking are discussed below:

Six Dimensions of Learning Experience Design: In 2014, Miller published an article that outlined his approach to effective learning design. Miller adapted six dimensions that serve as a starting point for thinking about and evaluating learning design. The six dimensions are attractiveness, efficiency, clarity, dependability, stimulation, and novelty. The details of each dimension are shown in Table 1.

Table 1

Six Dimensions of Learning Experience Design

Dimension	Description
Attractiveness	This dimension focuses on the learner's general impression of the learning experience.
Efficiency	This dimension focuses on information delivery and what is necessary to support learning activities and performance.
Clarity	This dimension focuses on the content of the learning experience and considers if the learning experience is clear and easy to follow.
Dependability	This dimension focuses on the predictability, consistency, and relevancy of the learning experience.
Stimulation	This dimension focuses on engagement and interactivity of the learning experience.
Novelty	This dimension focuses on the learner's attention and how innovative or creative the learning experience is.

Note. Adapted from "Six Dimensions of Learner Experience Design" by Benjamin Miller, 2014.

The Elements of User Experience: In 2010, Garrett published a second version of his book that addresses the five elements of user experience design. Garrett states that

elements build on one another and influence each other. The details of each element are show in Table 2.

Table 2

The Elements of User Experience

Dimension	Description
Surface	This element focuses on how the product is perceived through visual sensory (colors, images, text, etc.).
Skeleton	This element focuses on functionality and how the product will work.
Structure	This element focuses on the placement of interface elements and how they define user navigation.
Scope	This element focuses on the functional specifications and content requirements.
Strategy	This element focuses on the wants and needs of the user.

Note. Adapted from "The Elements of User Experience" by Jesse James Garrett, 2010.

These two approaches have slight variations, but remain similar to each other. The components of each approach may have different dimension names, but the focus for each is the same. The similarities in these approaches suggest that learning design requires concepts and methods from the domain of user experience design.

A common misconception of e-learning is that technology is the solution to make instruction more appealing (Keller & Suzuki, 2004). Innovative technology features are not enough to effectively motivate users without special attention to user experience design (Pilloni, Mulas, Piredda, & Carta, 2013). Learning design also goes beyond usability. People have different requirements when engaging with learning activities than they do when they are shopping online with a website. How users learn depends on their age, their level of content expertise, previous experience, learning styles, and motivations. User experience design has the capabilities to enhance the interface and usability of an e-learning training course to support all of these things (Peters, 2012).

While an attractive and usable interface is essential for e-learning training programs, good curriculum still remains as the most important element (Peters, 2012). A significant part of learning design is designing curriculum in a way that supports and enhances the cognitive process (Peter, 2012). This can be solved through the use of good instructional design principles. Instructional Design has the ability to support human psychological learning needs (Plaut, 2014). These guidelines are outlined in Table 3.

Table 3

Guidelines for Multimedia Learning

Principle	Description
Multimedia	People learn better from a combination of text and visuals rather than text alone.
Contiguity	Graphics should be relevant, not merely decorative. Printed words should appear near the corresponding graphic. Spoken words should be synchronized with the corresponding graphic.
Modality	Present words as speech whenever the graphic is the focus and both are presented simultaneously.
Redundancy	Do not add on-screen text to narrated graphics.
Coherence	Avoid e-learning with extraneous audio and graphics (i.e. background music, unrelated images, etc.).
Personalization	Use a conversational style tone and use virtual coaches to help guide the learner.

Note. Adapted from "E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning" by Ruth Colvin Clark and Richard E. Mayer, 2011.

A popular framework that many instructional designers use to develop curriculum is called the ADDIE model (Peterson, 2003). ADDIE is an acronym for Analyze, Design, Develop, Implement, and Evaluate. ADDIE has existed since 1975, when it was created for military training, and remains one of today's most effective systems for creating repeatable outcomes

(Smith, 1999). This model provides a very systematic approach to curriculum design and is purely focused on development and not necessarily creating a custom user experience (Smith, 1999). Product development is vital to the creation of curriculum, but the process of designing a learner-centered experience should not start and end with the product. The process should start and end with the learner (Plaut, 2014). One criticism of the ADDIE model is that it does not allow design thinking (Malamed, 2013). Design thinking acquires and synthesizes information to generate creative, human-centered solutions (Malamed, 2013).

In summary, learning design is a solution that combines the domains of both user experience design and instructional design. E-learning training programs need to be designed and developed with principles from both domains in order to be effective in the 21st century (Malamed, 2013). User experience design is not enough by itself because it does not incorporate educational theories and practices. Instructional design is no longer an effective solution by itself because the process focuses too much on the development of curriculum as a product instead of an experience. Learners and users have needs that can only be solved through proper research and design (Plaut, 2014). The ultimate goal for learning design is to create an environment that makes students more effective learners while also designing interfaces that make students want to learn (Plaut, 2014).

How Learning Design Can Increase Motivation

E-learning environments can be designed to encourage learner motivation by reducing cognitive load (Kim & Frick, 2011) and by applying motivational design strategies (Keller, 2010). Research has shown that if learners are motivated to learn, they are more likely to be engaged during the training. If the learners are engaged, then they are more likely to complete the training and achieve objectives (Rangel & Berliner, 2007).

One of the critical factors that leads to a decrease in learner motivation is cognitive load (Jones, 2013). The cognitive load of material can have a direct effect on the learner's satisfaction with (Bradford, 2011), perseverance through (Rangel & Berlinger, 2007), and retention of (Mayer & Moreno, 2003) online learning content. Cognitive load theory indicates that content presented in a way that exceeds the learners' cognitive capacity to absorb it hinders their ability to focus their attention on it (Hartley, 1999). Learning design can be used to address some of the cognitive barriers that are presented in e-learning training programs. Using a learner-centered approach, designers of e-learning courses not only focus on the instruction and presentation of content through the multimedia principles, but also the look and feel of the interface and how different elements function on screen. E-learning courses need to be designed to have an intuitive interface. Users become discouraged and overwhelmed when they are required to think too much about a decision before making it (Julien, 2012). The interface of an e-learning course should be easy for the user to understand. The less a user has to think about what he needs to do to achieve his goal, the more likely he is to achieve it (Krug, 2006). Creating an intuitive interface and following the multimedia principles of instructional design can increase student motivation to learn because they are not overwhelmed by the effort required to mentally persevere through the learning (Rangel & Berlinger, 2007).

The goal of learning design should be to address the question of *how* to create instruction that would stimulate motivation to learn (Keller, 2010). The focus is not on how people can be motivated, but on how the conditions can be created to have people motivate themselves. Keller's (2010) ARCS model of motivational design of instruction addresses four components of student motivation: attention, relevance, confidence, and satisfaction. According to this model, instruction will be more motivating if it:

1. Captures the *attention* and interest of the learner and stimulates curiosity. (p. 44)
2. Remains *relevant* to the personal needs or goals of the learner. (p. 45)
3. Helps the learner build *confidence* and make them feel that they will succeed. (p. 45)
4. Reinforces *satisfaction* with the learner through accomplishment or rewards (internal and external). (p. 45)

Each component in Keller's (2010) ARCS model can be divided into subcategories that further heighten learners' attention, increase their sense of information relevance, build their confidence, and enhance their satisfaction. For example, when focusing on the attention component, a designer might ask, *How can I create a learning experience that is stimulating and interesting?* The four main components and their subcategories are highlighted in Table 4.

Table 4

Motivational Categories and Subcategories

Category	**Description**	**Subcategory**
Attention	The instruction captures the attention and interest of the learner and stimulates curiosity	• Perceptual arousal • Inquiry arousal • Variability
Relevance	The instruction remains relevant to the personal needs or goals of the learner	• Goal orientation • Motive matching • Familiarity
Confidence	The instruction helps the learner build confidence and make them feel that they will succeed	• Learning requirements • Positive consequences • Personal responsibility
Satisfaction	The instruction Reinforces satisfaction with the learner through accomplishment or rewards (internal and external)	• Intrinsic reinforcement • Extrinsic rewards • Equity

Note. Adapted from "Motivational Design for Learning and Performance" by Keller, 2010. Copyright 2010 by NY: Springer US.

Implementing motivational components can help hold the learners' interest and perseverance during their progress through the e-learning training. User experience design attributes and instructional design principles have an impact on learners' motivation. Figure 1 exhibits a more learner-centered approach that is needed to design high-quality e-learning.

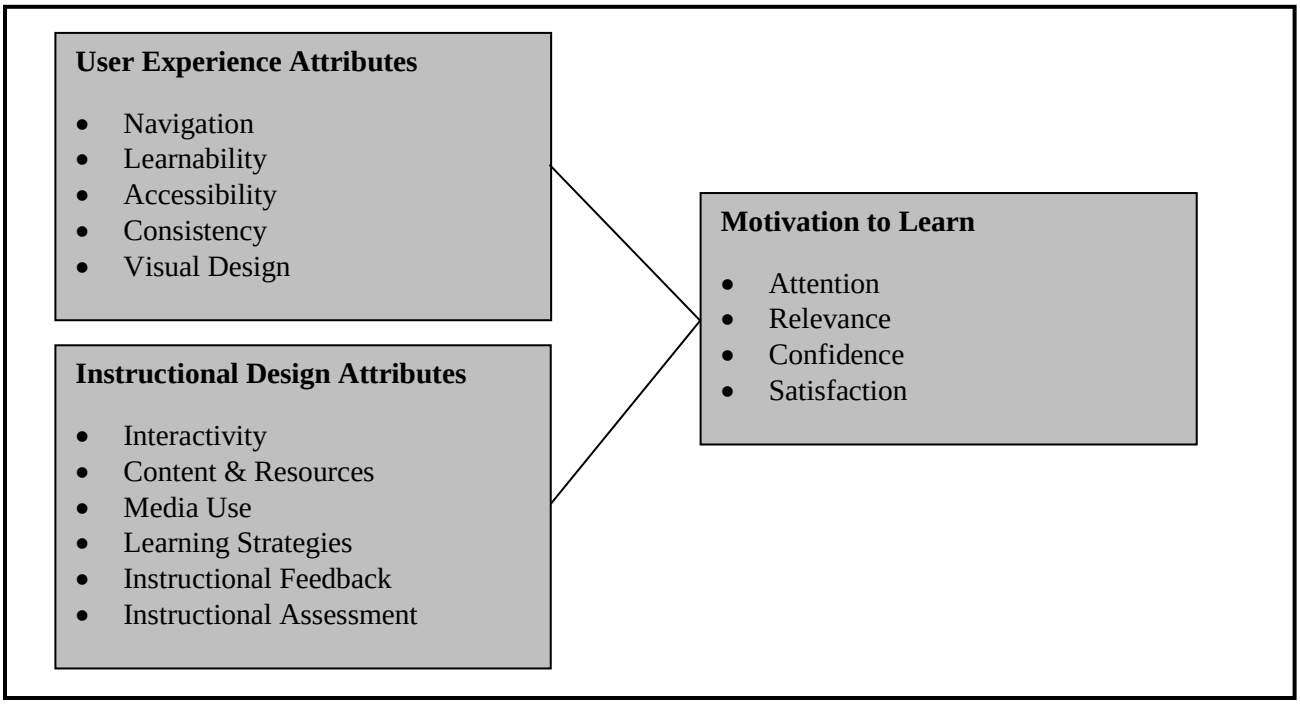


Figure 1. Adapted from "E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning" by Ruth Colvin Clark and Richard E. Mayer, 2011.

Summary

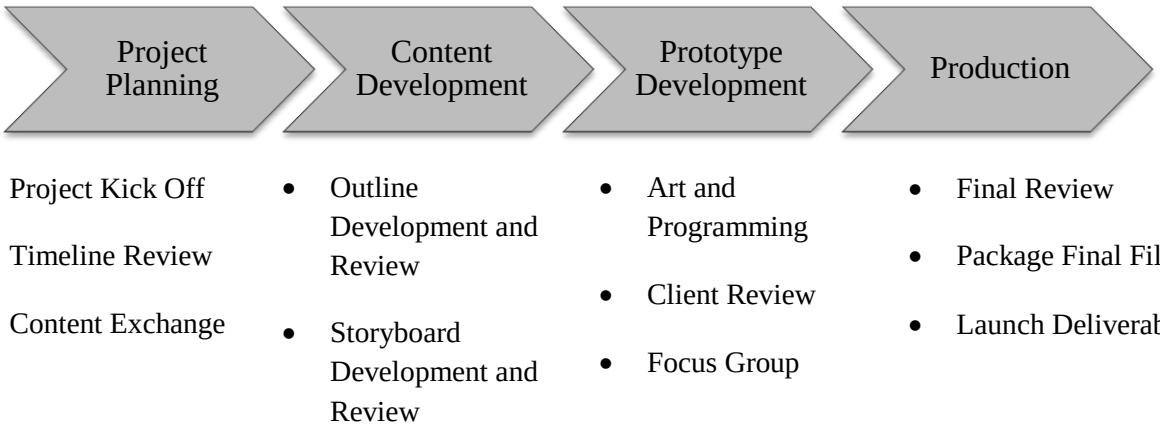
This section covered research done in the areas of user experience design and instructional design and how these domains can be combined to create a more learner-centered approach called learning design. Several factors were discussed including adult motivational factors, how learning design can increase motivation among adult learners, and how motivation can be evaluated using Keller's ARCS model (attention, relevance, confidence, and satisfaction).

SECTION II: PROCEDURES

Development Procedure

The first training program developed was intended to be a 20-minute, individual e-learning experience, designed to be completed through a web browser. The overall goal of this project was to implement key learning design and user experience design principles to create a more engaging, motivating, and interactive form of training.

In addition to a detailed timeline of events, this project was developed using the following process:



The process began with the Project Planning phase of the process. During this phase, the learning designer, developer, and client met face-to-face to officially start the project. The purpose of this meeting was to set expectations and exchange information and content. The client provided the learning designer and developer with the existing training materials and gave a brief overview of the content. Shortly following this initial meeting, the learning designer created a detailed timeline that outlined each step in the development process highlighting the major milestones and review dates.

The Content Development phase began after the content had been exchanged between the

learning designer and client. The purpose of the outline document was to establish the flow for the storyboard and ensure that the learning designer had the right learning objectives, content, and flow before building the detailed art or interactions. Once the learning designer had written the outline document, she reviewed this with the client to ensure that the:

- Learning objectives were correct
- Flow of content was appropriate
- Content had been streamlined accurately
- Questions had been answered and data provided
- Art and activities suggested complemented the content

Once the client and learning designer had reached an agreement on the outline document, the learning designer took the outline content and created a storyboard. The purpose of the storyboard was to continue establishing flow and text for the module, finalize art style and interactions, and collaborate on any improvements before the prototype development. After the storyboard had been developed, the learning designer reviewed the document with the client to ensure that the:

- Content supported the learning objectives
- Activities supported the learning objectives
- Story flowed well
- Suggested graphics and interactions were appropriate

During the Prototype Development phase, the learning designer created the art and the development team began programming the activities. There were several rounds of internal quality assurance meetings between the learning designer and development team before the working prototype was sent to the client for review. The purpose of the prototype review with

the client was to ensure that at least 90% of the course was complete and to make any improvements before the prototype was tested with actual users. During this review, the learning designer and client ensured that:

- All text told a clear story
- Visuals and activities supported the learning objectives and outcomes
- All activities functioned appropriately

After the prototype was approved by the client, the prototype was tested with a group of 3-5 subject matter experts. The purpose of this review was to test the module with users from the target audience to assess the learning based on content, visual representation, ease of understanding, and level of engagement. This review was completed virtually through an online conference.

After the focus group review with the subject matter experts was complete, the learning designer and client collaborated on the findings and determined what changes or edits to execute. The changes were then implemented by the learning designer and the developer to finalize the module. Once the changes had been made, the client was given one last opportunity to review the module. The purpose of the final review was to:

- Review incorporated changes from the focus group
- Determine any additional small changes to text, art, or activities
- Provide final sign off

The last part of the Production phase in the process was to provide the client with the final files and launch the e-learning module on the client's website to be introduced to all users.

Timeline

Tasks	Task Lead	Duration (Days)	Start Date	End Date
Rough Storyboard Review	Client	1	3/18/2015	3/18/2015
Send additional photos and feedback	Client	1	3/19/2015	3/23/2015
Final Storyboard: Rough storyboard edits Finalize storyboard	Learning Designer	3	3/24/2015	3/24/2015
Storyboard Review	Client	2	3/25/2015	3/25/2015
Send final storyboard feedback	Client	1	3/26/2015	3/30/2015
Update Final Storyboard	Learning Designer	1	3/31/2015	4/1/2015
Create TIM text file	Learning Designer	2	4/2/2015	4/2/2015
Art	Learning Designer	5	4/3/2015	4/3/2015
Programming	Developer	15	4/6/2015	4/7/2015
Internal QA and Proofing	Learning Designer	2	4/8/2015	4/14/2015
Programming Updates and Edits	Developer	2	4/15/2015	5/7/2015
Prototype Review	Client	1	5/8/2015	5/11/2015
Internal Client Review and Provide feedback	Client	2	5/12/2015	5/13/2015
Art, Text, Programming Updates and Edits	Learning Designer Developer	4	5/14/2015	5/14/2015
Subject Matter Expert Review	Client	3	5/15/2015	5/18/2015
Collect feedback	Client	1	5/19/2015	5/22/2015
Send focus group feedback	Client	1	5/26/2015	5/28/2015
Art, Text, Programming Updates and Edits	Learning Designer Developer	2	5/29/2015	5/29/2015
Final Review	Client	1	6/1/2015	6/1/2015
Website Deployment and Launch	Developer	1	6/2/2015	6/3/2015

Method for Evaluation

In order to evaluate the effectiveness and success of this project, the prototype of the learning module was administered to a group of 3-5 subject matter experts. Focus group reviews with subject matter experts are a key step in the development process, providing an opportunity for the target audience to give true user-testing feedback on the solution. At this stage of the development process, the e-learning module was approximately 90-95% complete and had gone

through several revisions.

Focus groups are ideal for determining what the audience wants, needs, and likes (Krug, 2006). During the focus group for this particular project, the learning designer and client assessed the learning on the basis of:

- Content
- Visual representation
- Ease of understanding
- Level of engagement and motivation

The ultimate goal of the review was to ensure that the solution met the target objectives and was successful in meeting the business need (Krug, 2006). For facilitating the focus group review, the learning designer used the following process:

Before

- The learning designer worked with the client to assemble a group of approximately 3-5 subject matter experts to go through the e-learning module.
- The learning designer sent out an introductory email (Appendix A) that defined the purpose of the session, what type of feedback the team was looking for, and how long the review should take.

During

- The participants completed the e-learning module on their own and at their own pace. Each person was given a feedback sheet (Appendix B) that they used to organize their comments.

After

- Participants then replied to the introductory email with their feedback form attached. This feedback was due by the date established in the timeline.
- Once the learning designer and client had received the feedback forms from all participants, they had a debrief meeting to review all comments from the participants. During this meeting, the learning designer and client came to a decision on how to revise the e-learning module based on the feedback and comments from the focus group review.

In addition to the feedback forms that each focus group review participant completed, the learning designer included general feedback questions (Appendix B) in the introductory email to elicit further thoughts and feedback comments.

SECTION III. DESCRIPTION/METHODOLOGY/DEVELOPMENT

Description

Following the development procedure, the original training materials were evaluated prior to writing the course outline. This early evaluation of the original condition of the training materials helped determine what needed to be improved for the purpose of this project. Figure 2 and Figure 3 illustrate the layout of what a typical screen looked like in the training materials.

The original condition of the training materials showed no evidence of user experience design attributes or instructional design attributes. The training PowerPoint did not include clear navigation, consistency, visual design, interactivity, or user feedback. The lack of user experience design attributes and instructional design attributes provided no motivation for the user to learn.

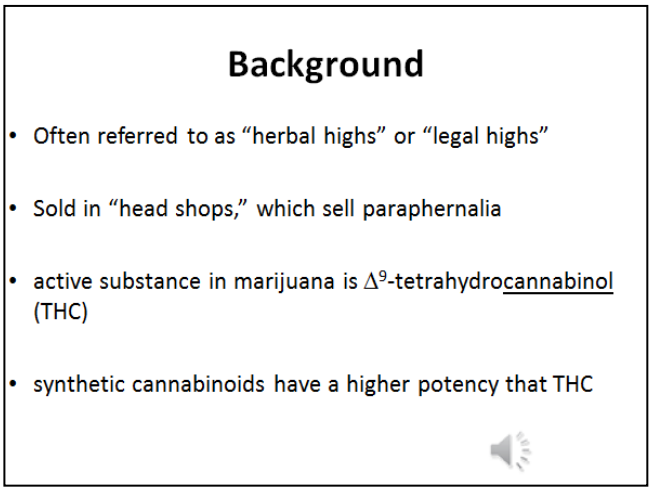


Figure 2. Screen 12 from original training.

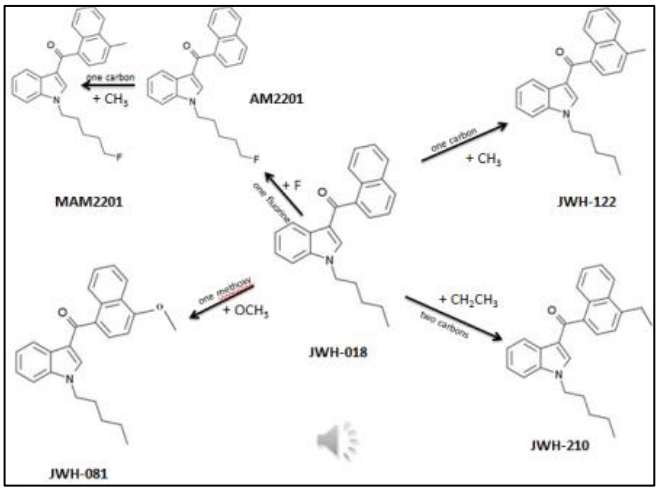


Figure 3. Screen 2 from original training.

Development

After the evaluation of the original training materials, the learning designer was able to write the outline that established the flow for the storyboard and ensured that the learning designer had the right learning objectives, content, and flow before building the detailed art and

interactions. The outline was developed using PowerPoint so that the content could easily be organized by screen. Once a flow was established and confirmed by the client, the learning designer continued to develop the outline into a storyboard. The purpose of the storyboard was to provide more accurate art samples and activities that the end user might interact with. Examples of how the outline was developed into the storyboard are illustrated in Figures 4 and 5.

Figure 4. Screen 1 Development Progress from Outline to Storyboard

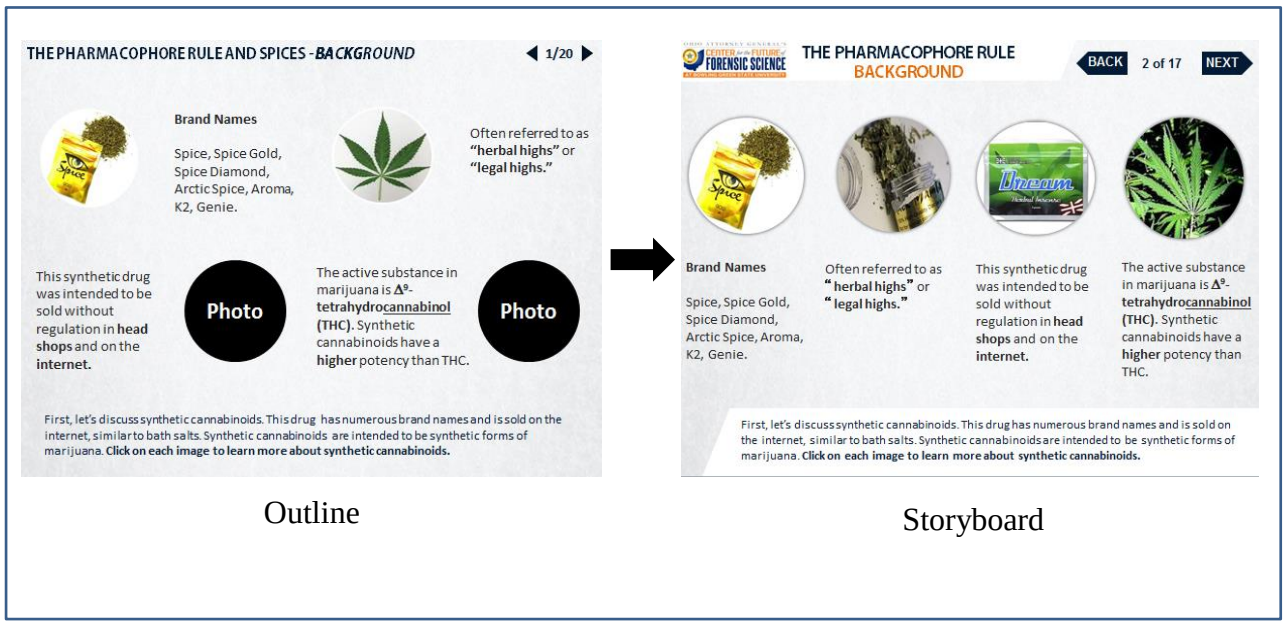
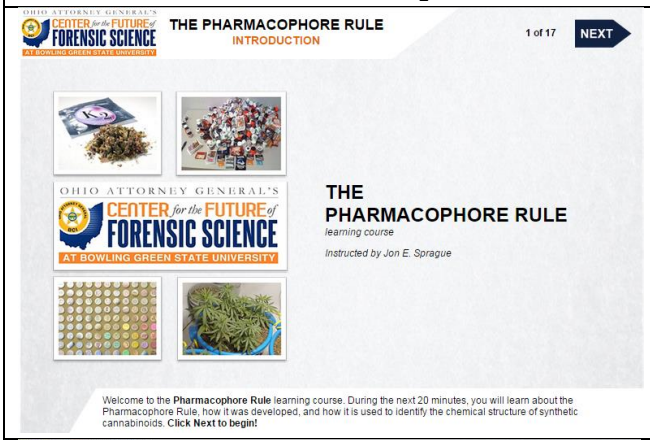
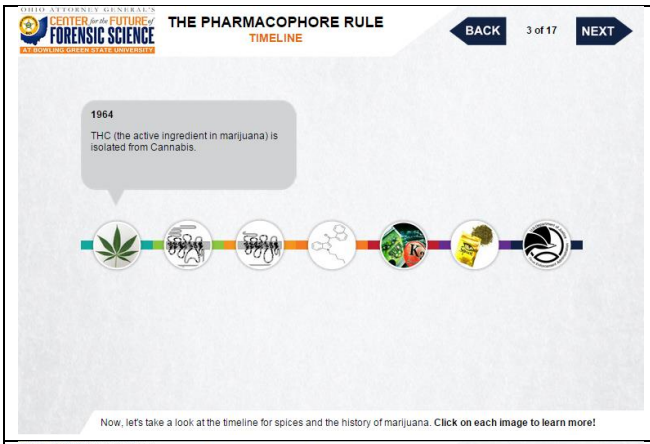


Figure 5. Screen 2 Development Progress from Outline to Storyboard

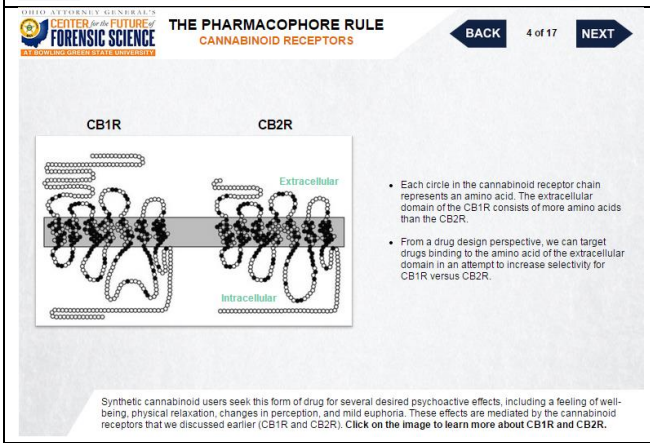
Once the storyboard was finalized and approved by the client, the learning designer created all of the individual art assets needed for the new training module. Following the art creation, the programming team began development on the working prototype. A comprehensive table is shown that includes a screenshot of each page from the prototype and a description of the interaction if applicable. This version that was presented to the client prior to the focus group test.

The Pharmacophore Rule *learning course* (Prototype Version)	
	**Page 1:** Introduction This page shows the course name, the instructor's name, the organization's logo, and some introductory text that welcomes the user to the course.
	**Page 2:** Background This page includes four photos of synthetic drugs. The user must click on each photo to reveal the text in order to learn more about the background of synthetic cannabinoids.



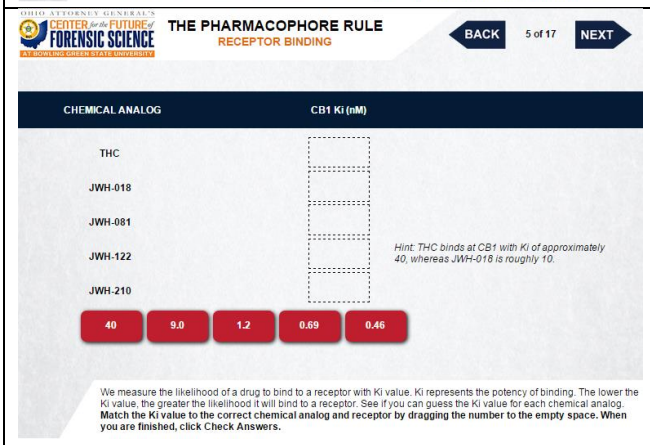
Page 3: Timeline

This page includes an interactive timeline where the user can click on the different sections to reveal a pop-up box. Each pop-up box contains a relevant photo and information to teach the user about the history or marijuana.



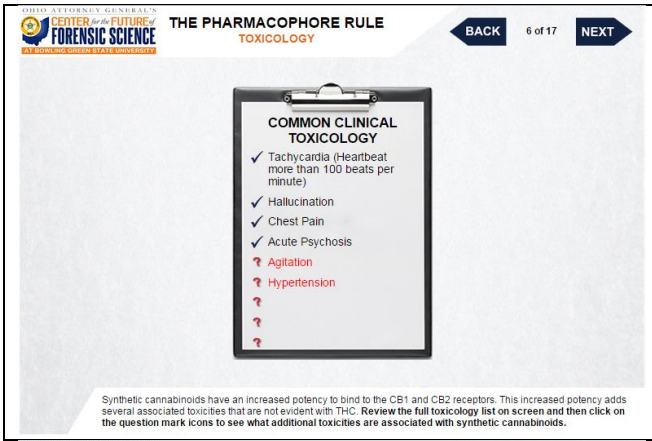
Page 4: Cannabinoid Receptors

This page explains synthetic cannabinoids. There is a graphic that shows the difference between the two types of cannabinoid receptors.



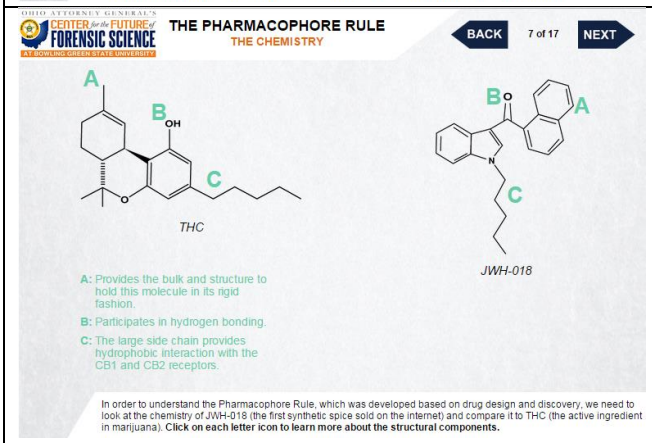
Page 5: Receptor Binding

This page is guessing game that follows-up on the Cannabinoid Receptor information. The activity is a matching game where the user will match the potency value to the correct cannabinoid receptor. The user is given one try to correctly guess. If they guess incorrectly, the module will show them the correct answers.



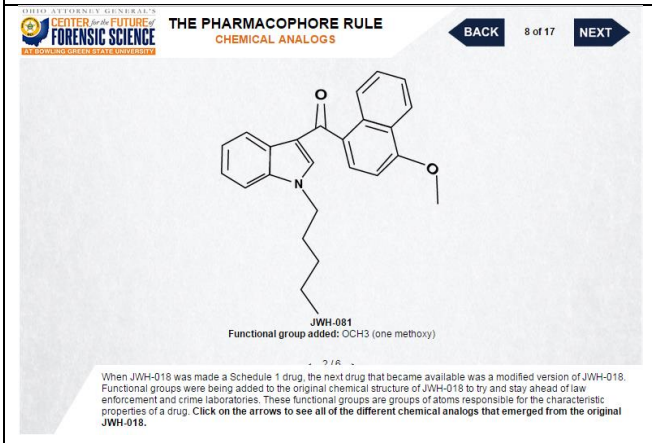
Page 6: Toxicology

This page discusses the toxicities that are associated with synthetic cannabinoids. The user must click on each question mark icon to reveal the toxicities.



Page 7: The Chemistry

This page illustrates the chemical differences between marijuana and synthetic marijuana. Each letter on the screen represents the structural components that are present in both substances. The user must click on each letter icon to reveal the text and to see where the structural component appears in each molecule.

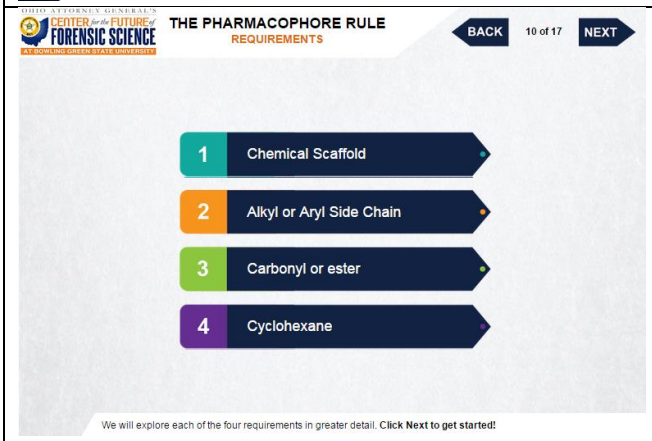


Page 8: Chemical Analogs

This page is meant to teach the learner how synthetic marijuana has developed and what chemical analogs were changed in each development. The user must click through the photo viewer to see each structure. At the end, the user will see all of the photos together so that they understand how everything is connect and linked together.

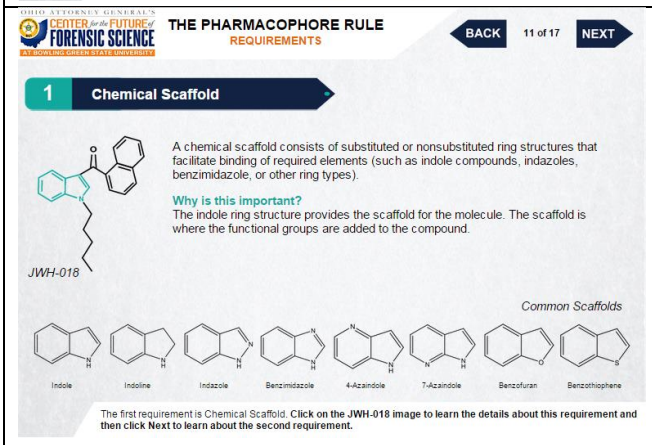
Page 9: The Basics

This page is meant to introduce the Pharmacophore Rule and the impact that it has in law enforcement. The user must click on each icon to reveal some introductory text.



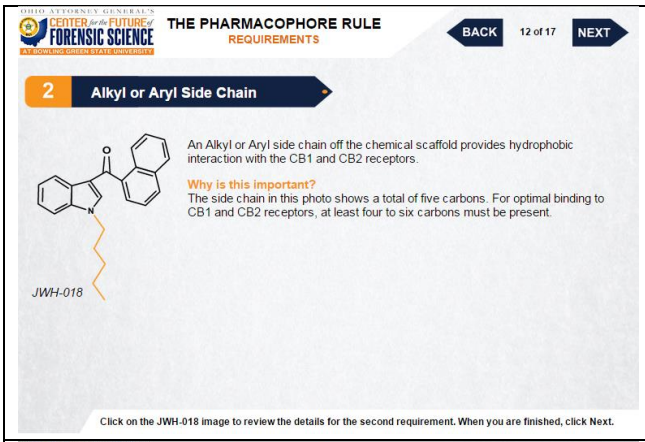
Page 10: Requirements

This page continues to introduce users to the Pharmacophore Rule. It is explained on this page that there are four requirements to the Pharmacophore Rule and that the user will learn about each one in detail over the next several screen.



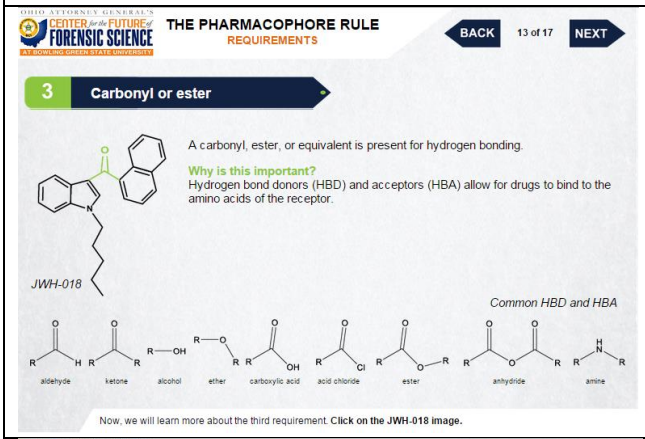
Page 11: Requirements (continued)

This page introduces the details of the first requirement. The user must click on the image to the left to reveal the text.



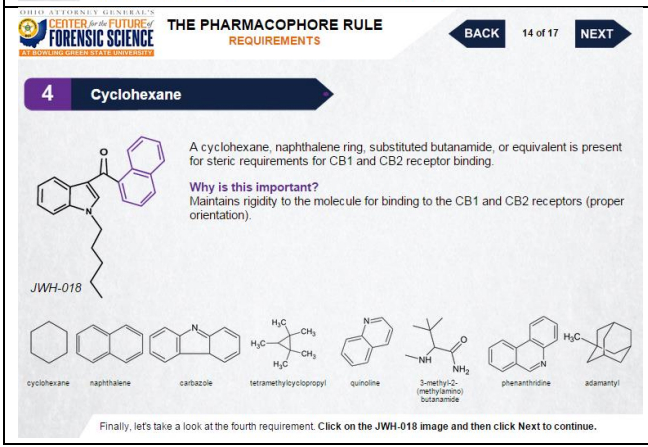
Page 12: Requirements (continued)

This page introduces the details of the second requirement. The user must click on the image to the left to reveal the text.



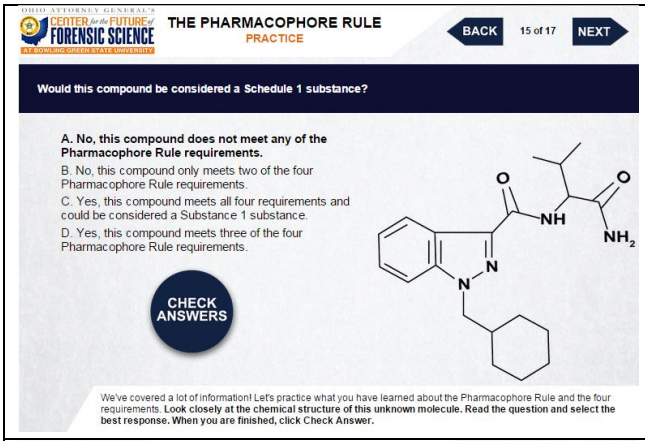
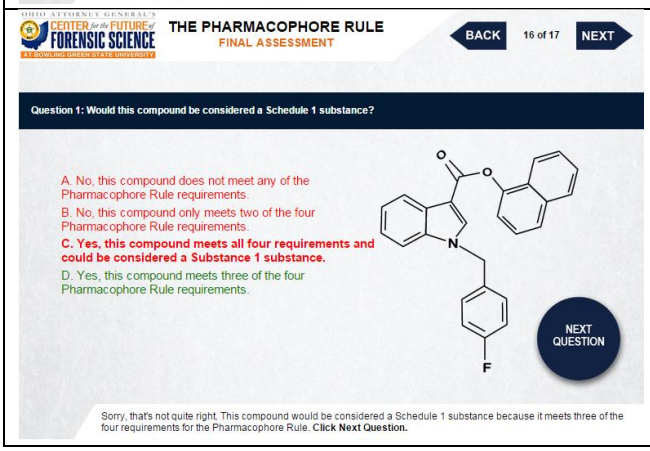
Page 13: Requirements (continued)

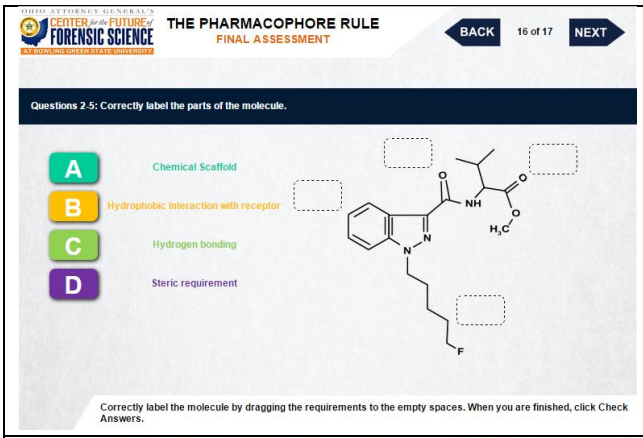
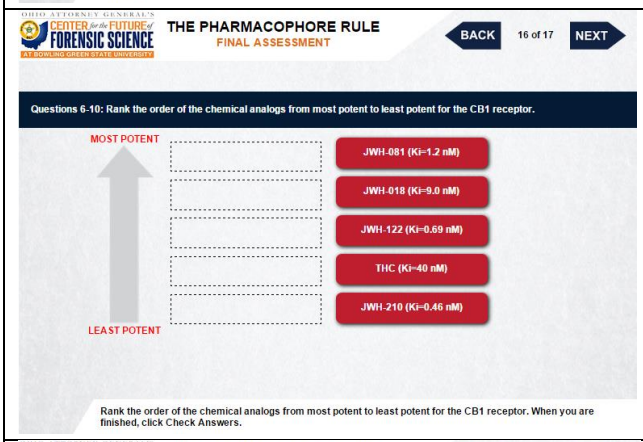
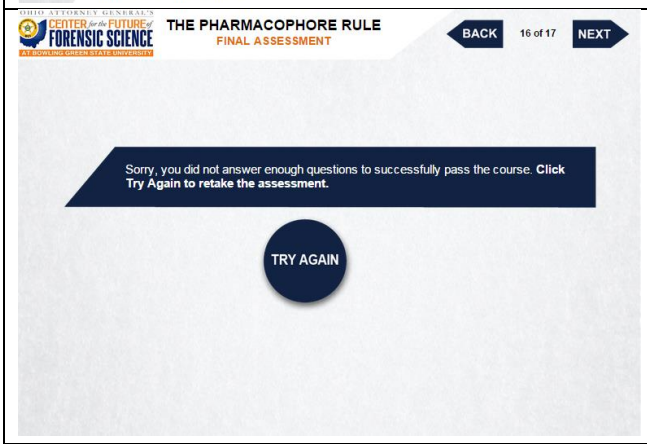
This page introduces the details of the third requirement. The user must click on the image to the left to reveal the text.



Page 14: Requirements (continued)

This page introduces the details of the fourth requirement. The user must click on the image to the left to reveal the text.

	**Page 15:** Practice This page is meant to be a practice exercise to test the user's knowledge on what they just learned on the previous screens. The user must look at the chemical structure and determine if the molecule shown is considered a Schedule 1 substance.
	**Page 16:** Final Assessment This page introduces the user to the final assessment. The user must score atleast an 80% or better to pass the module and obtain their certificate of completion.
	**Page 16:** Final Assessment – Question 1 Question 1 in the final assessment is similar to the practice activity. The user must look at the chemical structure and determine if the molecule shown is considered a Schedule 1 substance.

	**Page 16:** Final Assessment – Question 2 - 5 Questions 2-5 are a matching activity. The user must correctly label the molecule by dragging the requirements to the empty spaces.
	**Page 16:** Final Assessment – Question 6-10 For the final questions, the user must rank the order of the chemical analogs from most potent to least potent.
	**Page 16:** Final Assessment – Summary The last page of the final assessment informs the user if they successfully passed the assessment. If the user did not score at least an 80%, then they must retake the assessment again. If the user passed, they are allowed to move on to the conclusion screen.

	**Page 17:** Conclusion This page is the final page in the module. The user can click on the 'Print Certificate' button to save or print their certificate of completion.

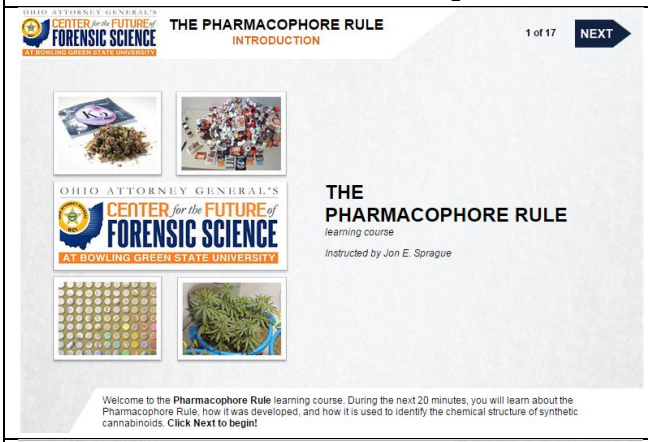
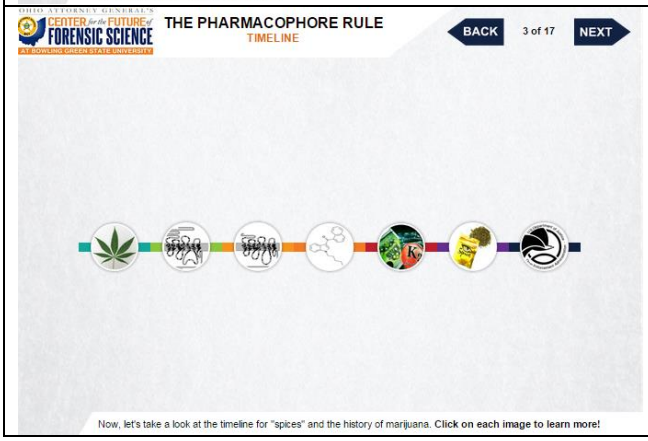
Table 6. Screenshots from the Module (Prototype Version)

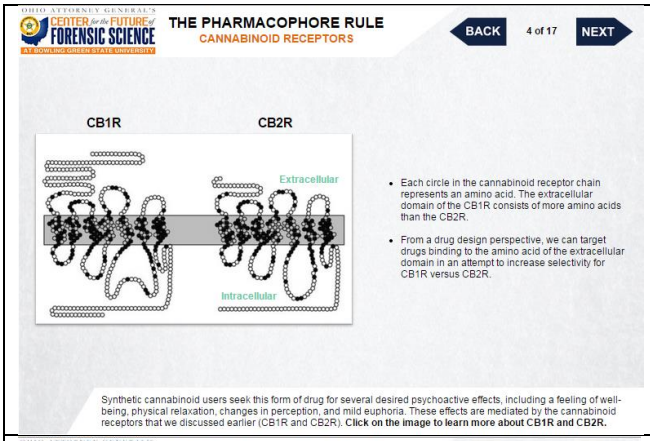
Following the prototype review with the client, very minor changes were made before hosting the focus group test with the identified subject matter experts. The client recruited five additional subject matter experts to review the learning module. These participants were chosen because they are experts in chemistry and have enough knowledge of the Pharmacophore Rule to be able to provide feedback on the accuracy and presentation of the content.

It was decided between the learning designer and the client to administer the focus group test virtually. When it was time to notify the subject matter experts, the learning designer composed an introductory email (Appendix A) that explained the purpose of the focus group test, what type of feedback was expected, and how to access the learning module. In addition to the introductory email, each participant was given a feedback form (Appendix B) to help capture their thoughts and comments as they completed the module. When the participants were finished with their review of the material, they were instructed to respond to the introductory email with their feedback form attached. Three participants completed the provided feedback forms (Appendices C, D, and E), one participant provided general feedback in an email message (Appendix F), and one participant did not review the module and provide feedback.

Once all feedback was collected, the learning designer organized the data in one spreadsheet. Then, the learning designer provided her recommendation for each edit requested by

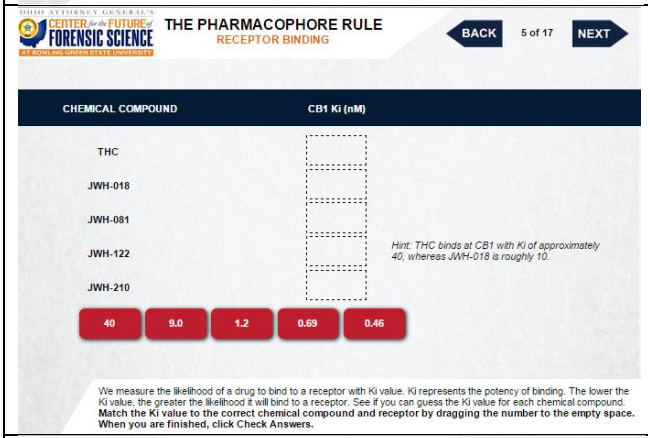
the subject matter experts. The client analyzed this information and made the final decision on what to change or if they agreed with the learning designer and developer's recommendations. Not all requested edits were implemented into the final version of the learning module. A comprehensive table is shown that includes a screenshot of each page from the final version of the module and a description of what changed from the prototype version.

The Pharmacophore Rule *learning course* (Final Version)	
	**Page 1:** Introduction No changes implemented.
	**Page 2**: Background The facilitator text at the bottom of the page was revised for accuracy.
	**Page 3:** Timeline The facilitator text at the bottom of the page was revised for accuracy.



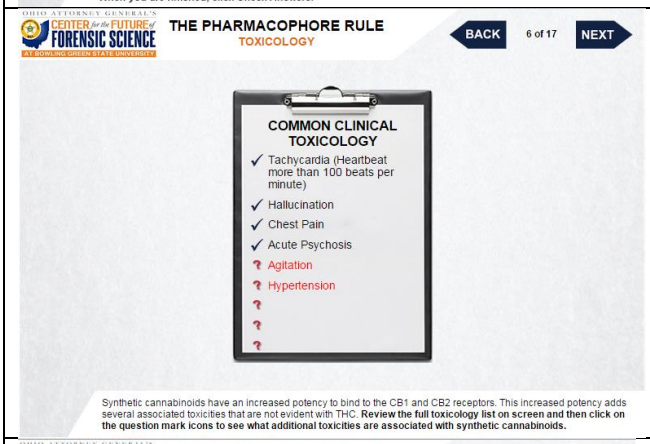
Page 4: Cannabinoid Receptors

No changes implemented.



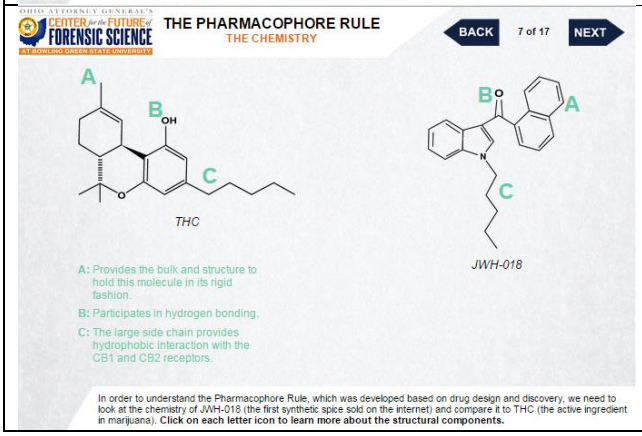
Page 5: Receptor Binding

The facilitator text at the bottom of the page was revised for accuracy.



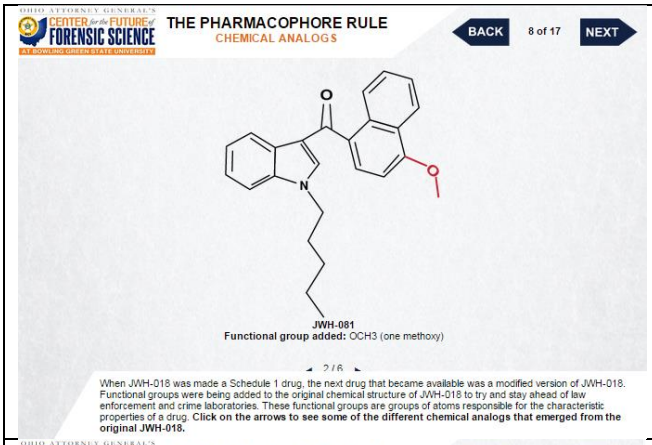
Page 6: Toxicology

No changes implemented.



Page 7: The Chemistry

No changes implemented.



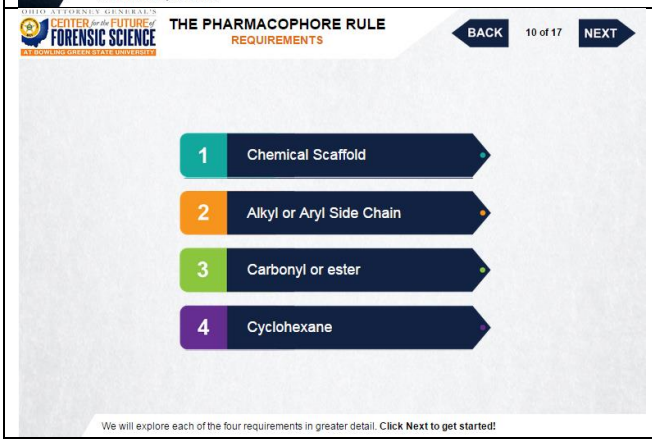
Page 8: Chemical Analogs

The facilitator text at the bottom of the page was revised for accuracy.

The artwork was revised to highlight the structural changes in each chemical analog.

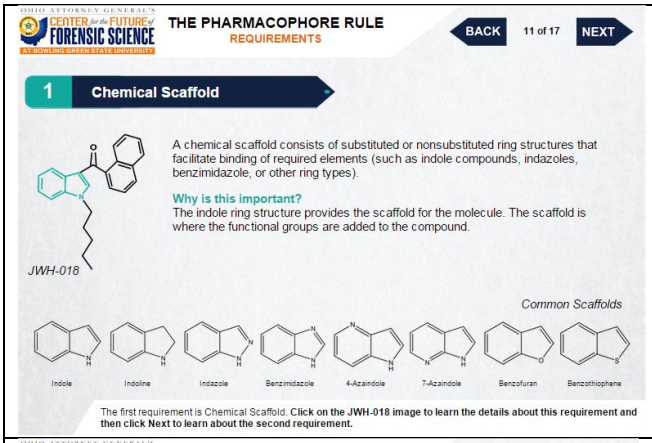
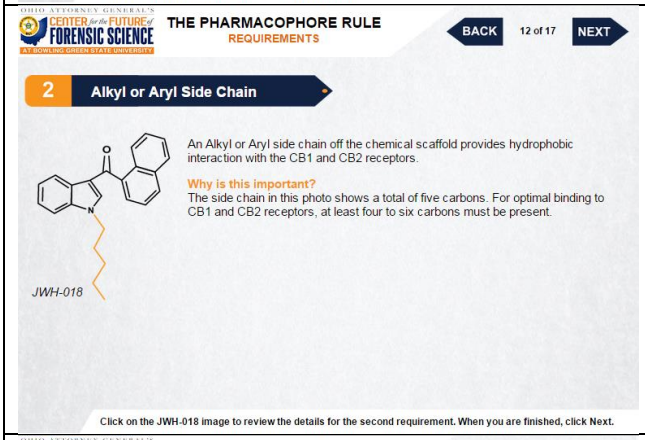
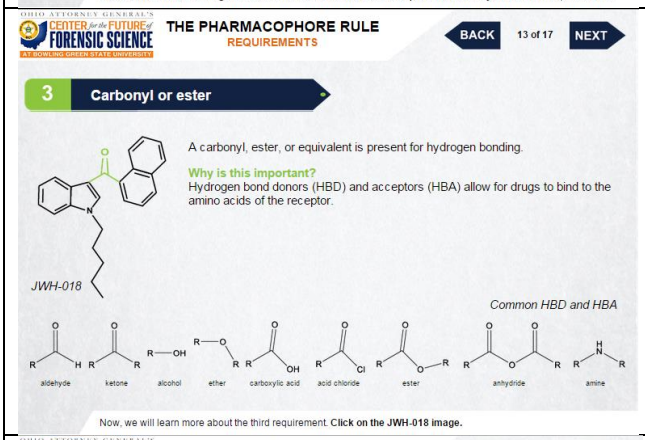
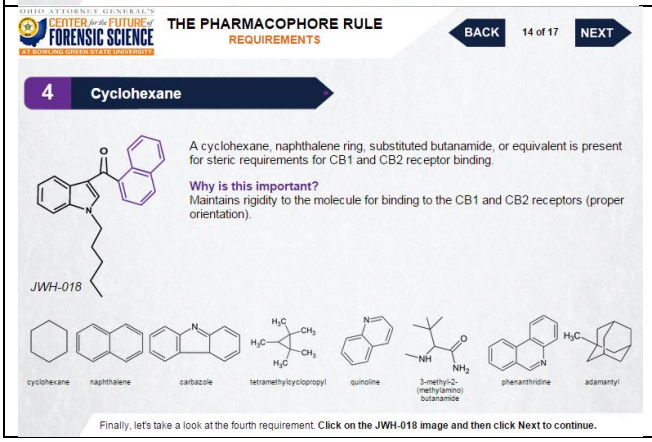
Page 9: The Basics

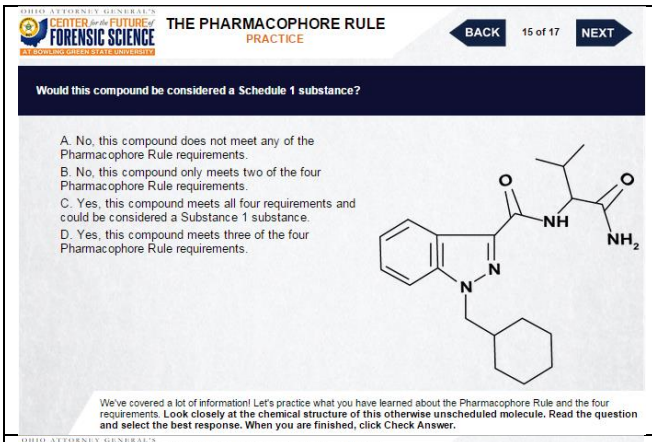
No changes implemented..



Page 10: Requirements

No changes implemented.

	**Page 11:** Requirements (continued) No changes implemented.
	**Page 12:** Requirements (continued) No changes implemented.
	**Page 13:** Requirements (continued) No changes implemented.
	**Page 14:** Requirements (continued) No changes implemented.

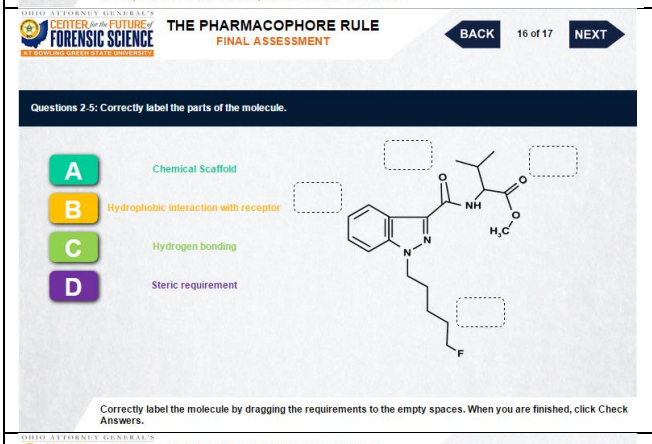


Page 15: Practice

The facilitator text at the bottom of the page was revised for accuracy.

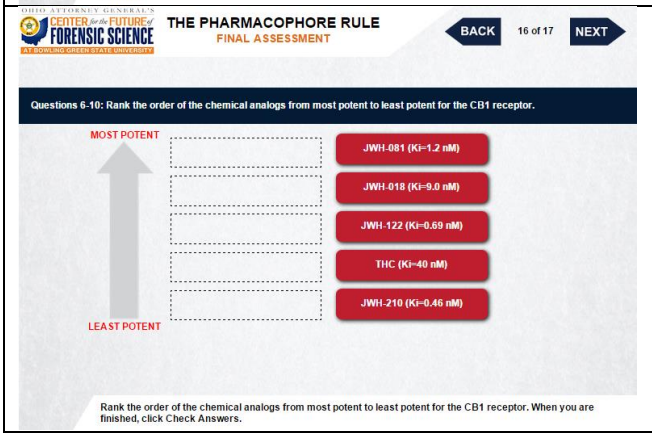
Page 16: Final Assessment – Question 1

No changes implemented.



Page 16: Final Assessment – Question 2 - 5

No changes implemented.



Page 16: Final Assessment – Question 6-10

No changes implemented.

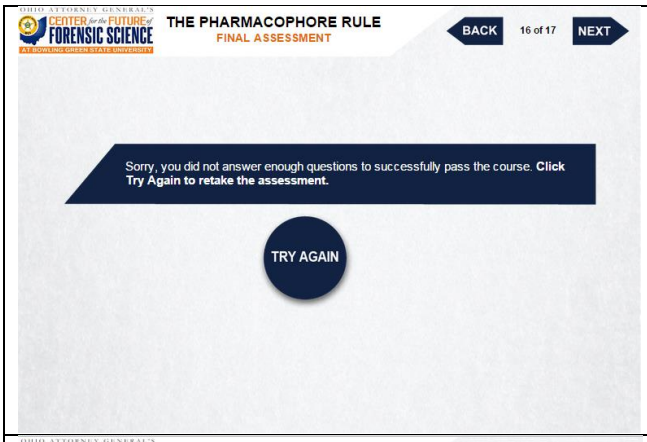
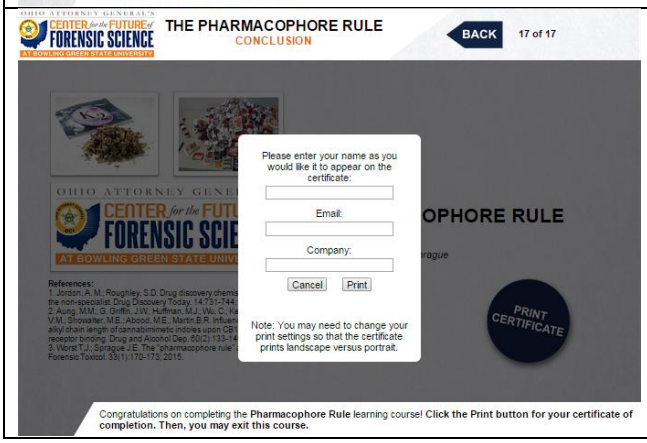
	**Page 16:** Final Assessment – Summary No changes implemented.
	**Page 17:** Conclusion No changes implemented.
	**Certificate** Include text that instructs the user to change their print settings so that the certificate will print landscape versus portrait.

Table 6. Screenshots from the Module (Final Version)

After the focus group feedback was implemented in the module, the client reviewed the module one last time to ensure the edits were accurate. The last step of the development process was to upload the module to the client's website and officially launch the module to the users.

SECTION IV. RESULTS/EVALUATON/RECOMMENDATIONS

Restatement of the Objectives

The objectives of this project were to:

(1) Evaluate the current condition of the training materials;

(2) Create a self-paced, 20-minute, online learning experience;

(3) Increase learner motivation through the use of learning design and user experience design principles.

Results and Evaluation

The first objective was met during the early stages of development. The learning designer evaluated the original condition of the training materials to determine what exactly needed to be improved or changed for the purpose of this project. The second and third objectives were met by completing the development of the learning module. During the focus group test, one participant reported that he or she was able to complete the entire experience in 15 minutes. Other participants reported that the experience took them longer due to the extensive review they completed. The final learning module was designed to be completed individually at the learner's own pace. The module will exist on the client's website where employees will be able to access it with a code given to them by the client. Two participants from the focus group test reported that they found the experience to be interactive and engaging while the majority of participants found the module easy to navigate and user-friendly.

Overall, the client seemed very pleased with the final version of the module and has already expressed interest in developing the remaining training materials in the same way as the Pharmacophore learning module. Sprague and Lynn were both impressed with the level of engagement and creativity built into the module. This approach to training is vastly different than

anything they have done in the past.

Recommendations

My recommendations for the future of this project and for the development of future projects with Ohio Attorney General's Center for the Future of Forensic Science at Bowling Green State University include changes to the timeline and process and adding in audio facilitation.

In general, the project process was well planned and executed. The client was unfamiliar with the development process, but trusted the learning designer and developer's experience and expertise. The client quickly adapted and was able to participate in each major milestone to provide timely feedback. For the future, if the plan is to develop multiple online learning modules, I recommend designing a more robust timeline with a staggered deliverable approach. Now that the client is familiar with the development process, the timeline for future modules may be able to overlap. For example, when the first module is in the prototype phase, the second module may start in the outline phase compared to finalizing one project before moving to the second.

My second recommendation would be to add an audio facilitator and other forms of media for future projects. This is something the learning designer addressed with the client early in the process for this current project. However, it was decided due to budget and timing that there would be no audio facilitation for this project. It would be beneficial to include audio and other forms of media, such as video, in the modules. Some learners prefer to read the instructions at the bottom of the screen; some prefer to listen to the instructions, and others like to read along with the audio. I would even recommend revisiting this current project at a future date to implement audio facilitation. This extra step in the process would need to be built into the

timeline to allow enough days for recording, editing, and implementing the audio clips.

Summary

This project was a test of everything that I have learned from the Learning Design graduate program at Bowling Green State University. My main role on this project was the learning designer with the responsibility of creating an engaging and motivating learning module. However, I also created the timeline and managed the project process from beginning to end. The most significant lesson learned was understanding the relationship between the learning designer and the subject matter expert. I relied heavily on the subject matter experts to provide me with the content and to also review what I designed for accuracy. Even though it is the subject matter expert's responsibility to provide the content, the learning designer must still make an effort to understand the content. If I had not spent significant time trying to digest, synthesize, and understand the chemistry content, I would not have been able to develop appropriate activities or a story, which were vital to the success of this project.

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APPENDIX A. FOCUS GROUP INTRODUCTORY EMAIL

Hello,

Over the past few months, The Center for the Future of Forensic Science at Bowling Green State University, Agile Oasis, and Jaclyn Kinsey have been working to create a new e-learning module that teaches researchers and scientists about The Pharmacophore Rule. Before we launch this module, we want to get your feedback to ensure the solution meets our targeted objectives and will be successful. We will review your feedback and incorporate your ideas into the module prior to our official launch. Please be open and honest with your feedback – this is your chance to leave your thumbprint on this very important training initiative.

This email contains information on how to view the course and provide feedback. The course will be available **5/15 through 5/18** for you to review the module and provide feedback.

Review of the Prototype
A few notes about the prototype:

1. For a prototype, we ask that you pay close attention to the following:
    1. Content
    2. Visual representation
    3. Ease of understanding
    4. Level of engagement and motivation

2. Please take notes during your review and provide feedback on the attached form. Capture any screen specific comments on the table including page number and detail about any problem or mistake you encounter. After you complete the course, complete the questions on page 2. Please send the completed form to Jon E. Sprague jesprag@bgsu.edu and Jaclyn Kinsey at jkinsey@bgsu.edu by 5/18 end of day.

3. **To access the module, please visit the following link:**
   http://forensic.project.agileoasis.com/one

We greatly appreciate your time and commitment.

Kind Regards,

Jon E. Sprague and Jaclyn Kinsey

APPENDIX B. FOCUS GROUP FEEDBACK FORM

The Pharmacophore Rule E-learning Module Feedback Form – Page 1 of 2

Please record feedback for any specific screens using the table below and then answer the questions at the end of the document.

Screen	Type of Issue	Comments

The Pharmacophore Rule E-learning Module Feedback Form – Page 2 of 2

After completing the course, answer these questions.

Overall:

1. What is your overall impression of this module?
2. What suggestions would you have for improving the module?
3. Approximately how long did it take you to complete the module (minutes)?

Ease of use:

1. How would you describe the program navigation?
2. Are the instructions for the activities easy to understand?

Interaction:

1. How did you feel as you progressed through the module? Was it too long or too short?
2. What particular activities held your attention most and least?

Content:

1. How would you describe the quantity of information provided?
2. What areas you would have liked to have additional information?
3. What were the key items you learned during the training?
4. What other questions do you still have?

APPENDIX C. PARTICIPANT 1 FEEDBACK FORM

The Pharmacophore Rule E-learning Module Feedback Form – Page 1 of 2

Please record feedback for any specific screens using the table below and then answer the questions at the end of the document.

Screen	Type of Issue	Comments
2	Text	First, let's discuss synthetic marijuana. These drugs have numerous brand names and are sold on the internet, similar to bath salts. Synthetic marijuana compounds are intended to be alternative forms of marijuana. **Click on each image to learn more about synthetic marijuana.**
3	Text	Consider putting spices—in the footer sentence—in quotes.
5	Text	Consider replacing the term "chemical analog." Analog is a term of art in the Revised Code. Perhaps "compound," may work better.
8	Text	When JWH-018 was made a Schedule 1 drug, the next drug that became available was a modified version of JWH-018. Functional groups were being added to the original chemical structure of JWH-018 to try and stay ahead of law enforcement and crime laboratories. These functional groups are groups of atoms responsible for the characteristic properties of a drug. **Click on the arrows to see some of the different chemical analogs that emerged from the original JWH-018.**
9	Imagery	AM2201 is missing a carbon in the chain (slides 5 and 6); the arrows on the right are facing the wrong way (slide 6)
15		Any interest in taking D and presenting it in the negative for those who might have missed that only three of the four elements are required? Also consider changing "unknown" in the footer language to "otherwise unscheduled" or "otherwise non-controlled."

The Pharmacophore Rule E-learning Module Feedback Form – Page 2 of 2

After completing the course, answer these questions.

Overall:

1. What is your overall impression of this module? Professional appearance; definitely meant for someone with a foundational knowledge of chemistry coming in.

2. What suggestions would you have for improving the module? See comments above.

3. Approximately how long did it take you to complete the module (minutes)? I didn't complete the module in one block of time.

Ease of use:

1. How would you describe the program navigation? User friendly.

2. Are the instructions for the activities easy to understand? Yes.

Interaction:

1. How did you feel as you progressed through the module? Was it too long or too short? Reasonably paced.

2. What particular activities held your attention most and least? Reviewing the module as assigned, I don't know that any one activity held my attention more than another.

Content:

1. How would you describe the quantity of information provided? Good so long as everyone who takes it understands that they need to have an understanding of basic organic chemistry before taking.

2. What areas you would have liked to have additional information? None.

3. What were the key items you learned during the training? I know that I've heard an explanation of some of the underlying pharmacological concepts, however, reading about those same concepts made it clearer.

4. What other questions do you still have? None.

APPENDIX D. PARTICIPANT 2 FEEDBACK FORM

The Pharmacophore Rule E-learning Module Feedback Form – Page 1 of 2

Please record feedback for any specific screens using the table below and then answer the questions at the end of the document.

Screen	Type of Issue	Comments
2	Text	The second sentence on the screen (before clicking on any images) starts "This drug". It feels awkward to me in the singular, because there are many different drugs present in various SC products. Text associated with Image 3 also has the same singular/plural issue. Text associated with Image 4 states that SCs have a higher potency than THC. This isn't completely accurate without additional words (b/c some SCs aren't more potent than THC)
3	Text	JWH-018 is not the first synthetic cannabinoid. HU-210 was synthesized in 1988. CP-47,497 has a publication date in 1982. (I don't know what the actual first SC was)
3	Text	The 2011 scheduling action scheduled 5 SCs. I feel that "including" might be better than "specifically". Also, the use of a ";" strikes me as odd, because "specifically JWH-018" is not an independent clause.
5	Interactivity	This seems like a way to force interactivity. It is interesting content, but a normal user would have no viable way to formulate guesses, nor is much learned by trying.
7	Text	CP-47,497 and its C8 homolog appeared at virtually the same time as JWH-018. "First" seems a touch strong
8	Imagery	Arrows for JWH-122 and JWH-210 should point to the right. Update! When I'm click back through trying to address the problem I had below with 12, this has been corrected.
8	Text	"all of the different chemical analogs". All is an overstatement.
12	Connectivity	No image of JWH-018 to click on. Was in Internet Explorer (seems to be what was recommended to fix Barb's variation of this problem.) Tried a few iterations of "refresh" and "back". Attached an image of what that ended up looking like. Clicked back through and it was working.
13	Imagery	I would include an image of an amide (which are somewhat common right now). For spacing, Replace it for acid chloride or anhydride (which we haven't seen)
14	Imagery/Text	What is labeled as 3-methyl-2- (methylamino) butanamide Is actually 3,3-dimethyl-2-(methylamino)butanamide. Both are common, so changing either the image or text would be acceptable.
15	Imagery/Text	It labels group 4 [which, interestingly to me, is the 3-methyl-2-(methylamino)butanamide group that was written but not pictured on slide 14] as "cyclohexane"
16	Connectivity	Clicked "finish" after questions "6-10". It did not progress to page 17 without hitting next. It seemed like it should.

The Pharmacophore Rule E-learning Module Feedback Form – Page 2 of 2

After completing the course, answer these questions.

Overall:

1. What is your overall impression of this module? It seems to cover the material pretty well. It was highly interactive and had more time invested into bells and whistles than I would have worried myself with (if you know me, that's a good thing for general consumption).
2. What suggestions would you have for improving the module? I would include test / activity questions where between 0 and 3 elements were met. It would also be helpful to have a 3 out of 4 molecule present and have the MC question be "which element is not met?"
3. Approximately how long did it take you to complete the module (minutes)? A highly qualified 1 hour. I spent a fair amount of time researching things I didn't think were right and taking notes above. If I was just clicking through for comprehension, I could have done the course in about 10 minutes. Then again, I am probably a bit more advanced on this topic than the target audience.

Ease of use:

1. How would you describe the program navigation? Easy when it was working, a little buggy at times. It seems like leaving the tab I was in to investigate other things may have been a contributing factor to buggyness. Also, my workplace firewall asked us qualified "Are you sure about this website" questions several times, which may or may not have been problematic.
2. Are the instructions for the activities easy to understand? Yes

Interaction:

1. How did you feel as you progressed through the module? Was it too long or too short? If anything, a little too short. But I enjoy multi-hour lectures on drug chemistry, so take my thoughts with a grain of salt.
2. What particular activities held your attention most and least? As I mentioned above, guessing Ki values from scratch seemed not very useful. I thought labeling which part of the structure met which part of the pharmacophore rule was an effective way to assess the crucial part of the course.

Content:

1. How would you describe the quantity of information provided? I wouldn't trust my answer to this question, because I'm not really the audience. I could have rambled for many moons on the history of synthetic cannabinoids. These rambly moons aren't actually essential to the material that is being taught (the pharmacophore rule).
2. What areas you would have liked to have additional information? I would do more "does this meet?" questions. Again, the answer being "no" sometimes would be helpful too.
3. What were the key items you learned during the training? I don't mean to sound arrogant, but I feel like I had this content pretty well mastered prior to taking the course.
4. What other questions do you still have? None.

APPENDIX E. PARTICIPANT 3 FEEDBACK FORM

The Pharmacophore Rule E-learning Module Feedback Form – Page 1 of 2

Please record feedback for any specific screens using the table below and then answer the questions at the end of the document.

Screen	Type of Issue	Comments
8	Imagery	JWH-122 and JWH-210 are pointing to JWH-018, the arrows should be pointing away from JWH-018 (internet explorer only, google chrome was correct).
16		If the person answered a question incorrectly, I would like to see an explanation of why the answer was incorrect, not just the correct answer by itself.

The Pharmacophore Rule E-learning Module Feedback Form – Page 2 of 2

After completing the course, answer these questions.

Overall:

1. What is your overall impression of this module? Good introductory coverage, maybe not comprehensive enough for educational purposes.
2. What suggestions would you have for improving the module? Include examples of the drug discovery process so the user has a better understanding of why the small changes can make a big difference.
3. Approximately how long did it take you to complete the module (minutes)? Not including intentional choosing wrong answers on the assessment and going through the process in both Internet Explorer and Google Chrome, probably 15 minutes.

Ease of use:

1. How would you describe the program navigation? Simple and easy to use.
2. Are the instructions for the activities easy to understand? Yes

Interaction:

1. How did you feel as you progressed through the module? Was it too long or too short? Length was appropriate for the material covered. As stated above, more detail about drug discovery would boost learning and understanding of the purpose of the rule.
2. What particular activities held your attention most and least? Hard to answer because this was reviewed for content and editorial purposes, not just learning. But, the 4-slide breakdown of the structural requirements of the rule was the most interesting to me.

Content:

1. How would you describe the quantity of information provided? While good for introductory purposes, I think adding more content would be beneficial.
2. What areas you would have liked to have additional information? Drug discovery process, in-text citations and more examples/quizzes regarding the use of the rule.
3. What were the key items you learned during the training? Nothing. Except the re-enforcement that Jon Sprague is cool – Happy Birthday
4. What other questions do you still have? Nothing not already mentioned.

APPENDIX F. PARTICIPANT 4 GENERAL COMMENTS

1. I really like the interactive segments of the course. It kept me engaged and I liked that it quizzed me.

2. I also liked the fact that you could not move on until you completed the page. Assures that the student does complete the work (so they can get a certificate)

3. Could page 3, image 4, *"endocannabinoid* "definition and page 4, information be simplified?

4. Page 8 of 17 could the changes that occur in each analog of JWH-081 be highlighted?

Comment 3 would apply if the course is to be taken by new chemists (or others) with little or no previous knowledge of pharmacophores or how they work (binding, effects…..)

Would this course be available to Attorneys, Law Enforcement or even Jurors?